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Indian Standard

SPECIFICATION FOR SYNTHETIC SEPARATORS FOR LEAD-ACID BATTERIES

(First Revision)

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Indian Standard

SPECIFICATION FOR SYNTHETIC SEPARATORS FOR LEAD-ACID BATTERIES

(First Revision)

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Indian Standard

SPECIFICATION FOR SYNTHETIC SEPARATORS FOR LEAD-ACID BATTERIES

(First Revision)

0. FOREWORD

0.1 This Indian Standard (First Revision) was adopted by the Indian Standards Institution on 5 March 1986, after the draft finalized by the Secondary Cells and Batteries Sectional Committee had been approved by the Electrotechnical Division Council.

0.2 This standard was first published in 1970. This revision has been undertaken with a view to update the contents and bring it in line with the International practice. This revision includes new tests for volume porosity and life test.

0.3 This standard applies to synthetic separators which are used in lead-acid batteries. Various types of such separators are being made in this country based on microporous rubber, PVC, polyethylene resin bonded paper to mention a few.

0.4 For the purpose of deciding whether a particular requirement of this standard is complied with, the final value, observed or calculated, expressing the result of a test or analysis, shall be rounded off in accordance with IS : 2-1960*. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

1. SCOPE

1.1 This standard covers the requirements and the methods of tests for synthetic separators used in lead-acid storage batteries.

NOTE — This standard does not cover the special type of separators whose prime function is to immobilize the electrolyte.

*Rules for rounding off numerical values (*revised*).

2. TERMINOLOGY

2.1 For the purpose of this standard, the definitions given in IS : 1885 (Part 8)-1986* shall apply.

3. MATERIAL

3.1 Materials used for making these separators shall be acid-resistant, such as, rubber, thermosetting or thermoplastic materials or their combinations, natural or synthetic resins or their blends, diatomaceous earth of similar inert materials or combinations thereof. Glass or cellulose may also be used in certain types as a base material. Separators may also be made by bonding fibre glass on one or both sides of the separators like resin bonded paper, microporous rubber, etc.

4. CONSTRUCTION

4.1 The battery separator, when used, shall maintain the electrical insulation between the plates and shall allow the electrolyte to permeate freely.

4.2 If the separators are provided with ribs, the separators shall be so designed that ribs do not become detached in service.

4.3 Separators shall be without any defects, such as cracks, fissures, pinholes when seen with naked eye or wrinkles.

4.4 Separators shall possess necessary flexibility for free handling.

5. DIMENSIONS AND TOLERANCES

5.1 The dimensions of the separator shall be as specified by the purchaser. The tolerances on the specified dimensions shall be as agreed between the purchaser and the supplier.

6. ELECTRICAL RESISTANCE

6.1 Unless otherwise specified by the purchaser, the electrical resistance of the separator, measured by the methods given in Appendix A shall be not more than 0·75 ohms cm^2/mm of thickness (web thickness in case of ribbed separators) (*see* Fig. 1).

7. CHLORINE CONTENT

7.1 The extractable chlorine content (as Cl) in the separator shall be determined by the method given in Appendix B and shall not exceed 30 mg per 100 g of separator.

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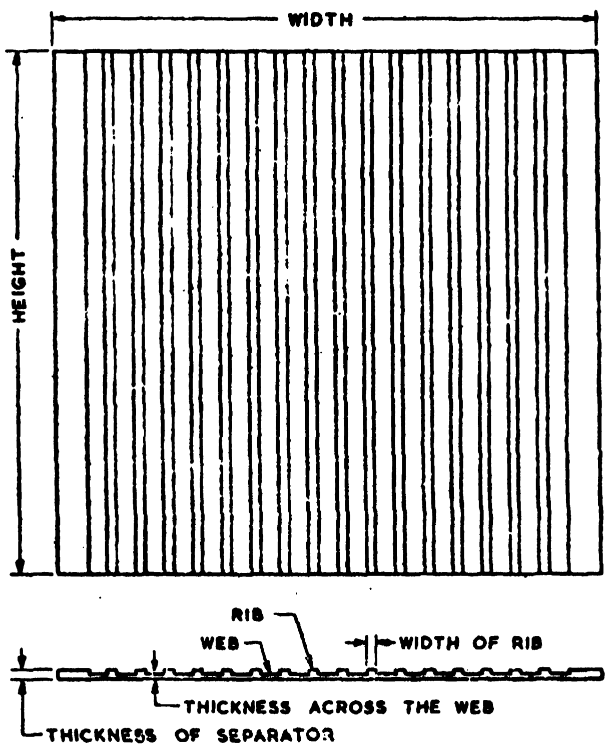
*Electrotechnical vocabulary: Part 8 Secondary cells and batteries (*first revision*).



NOTE — This figure is for the purpose of illustrations only.

FIG. 1 RIBBED SEPARATOR

8. IRON CONTENT

8.1 The extractable iron content (as Fe) in the separator as determined by the method given in Appendix C shall not exceed 60 mg of iron per 100 g of separator.

9. MANGANESE CONTENT

9.1 The manganese content (as Mn) in the separator as determined by the method given in Appendix D, and shall not exceed 1·5 mg per 100 g of the separator.

10. MAXIMUM PREDOMINANT PORE SIZE

10.1 The maximum predominant pore size shall be determined by the method given in Appendix E.

10.2 The value of the maximum predominant pore size should not exceed 50 µm.

11. VOLUME POROSITY

11.1 The volume porosity of the separator shall be measured by the method given in Appendix F.

11.2 The value of the volume porosity should not be less than 30 percent.

12. LIFE TEST

12.1 This test shall be carried out by the method given in Appendix G.

12.2 The life of the separator shall not be less than 150 hours.

13. TEST FOR MECHANICAL STRENGTH — Under consideration.

14. TEST FOR WETTABILITY OF SEPARATOR — Under consideration.

15. QUALITY OF REAGENTS

15.1 Unless otherwise specified pure chemicals and distilled water (*see* IS : 1070-1977*) shall be employed in tests.

NOTE — 'Pure chemicals' shall mean chemicals that do not contain impurities which affect experimental results.

16. PACKING AND MARKING

16.1 The separators shall be packed in moisture-proof packages.

16.2 Each separator package shall be legibly and indelibly marked with the following information:

a) Manufacturer's name or trade-mark,

b) Month and year of manufacture,

c) Type of separator,

d) Dimensions of separator,

e) Number of separators contained in the package, and

f) Country of manufacture.

16.2.1 Each package may also be marked with the ISI Certification Mark.

NOTE — The use of the ISI Certification Mark is governed by the provisions of the Indian Standards Institution (Certification Marks) Act and the Rules and Regulations made thereunder. The ISI Mark on products covered by an Indian Standard conveys the assurance that they have been produced to comply with the requirements of that standard under a well-defined system of inspection, testing and quality control which is devised and supervised by ISI and operated by the producer. ISI marked products are also continuously checked by ISI for conformity to that standard as a further safeguard. Details of conditions under which a licence for the use of the ISI Certification Mark may be granted to manufacturers or processors, may be obtained from the Indian Standards Institution.

*Specification for water for general laboratory use (*second revision*).

APPENDIX A

(*Clause* 6.1)

MEASUREMENT OF ELECTRICAL RESISTANCE OF SEPARATORS

A-1. AC METHOD

A-1.1 General

A-1.1.1 The resistance of a specially constructed cell is measured with the separator interposed across the path of the current under otherwise comparable conditions. In the first instance, the separator under test is used and the internal resistance of the cell determined; then a separator with a hole coinciding with the hole in the baffle is used and internal resistance of the cell again determined. The difference between the two measurements is the effective resistance of the separator.

A-1.1.2 A cell suitable for this test is illustrated in Fig. 2. It contains two baffles which have round holes of 9 cm diameter. When the separator is inserted between the baffles, the current flow is restricted to a separator area of about 65 cm^2, and hence the test gives the resistance over this area. The plates used in the cell are formed negative plates and should be renewed every few months.

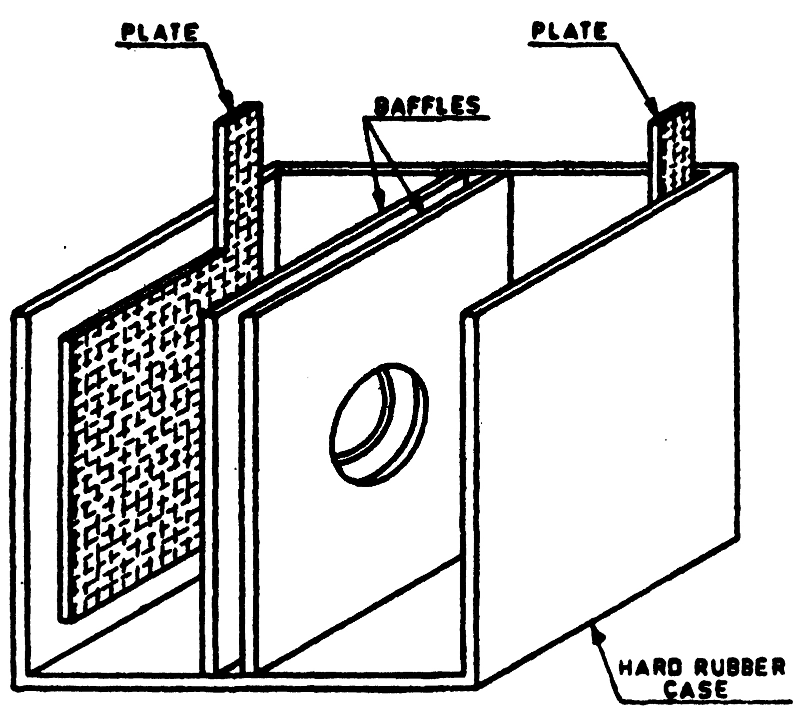


FIG. 2 CELL WITH NEAR SIDE REMOVED

A-1.2 Procedure

A-1.2.1 *Conditioning of Separator* — Keep the separator with and without holes in dilute sulphuric acid of specific gravity 1·280, prepared by suitably diluting concentrated battery grade sulphuric acid (conforming to IS : 266-1977*) for 24 hours before their resistance is measured.

A-1.2.2 Fill the cell to a level above the top of the baffle holes with sulphuric acid of specific gravity 1·280, prepared as described under **A-1.2.1** and maintain at a temperature of 27 ± 2°C as the resistance of separators varies considerably with temperature.

A-1.2.3 Measure the resistance of the cell with the separators with and without the hole, using an alternating current bridge such as that shown in Fig. 3, one arm being shunted with a variable condenser to obtain a reactive balance. The amplifier should contain a filter or other device to eliminate the effects of harmonics generated by the non-linear characteristics of the cell.

A-1.2.4 Report the difference in resistance with and without the hole in separator, as ohms per square centimetre of the face area of the separator. The resistance of the separator is then given by the following formula:

$$(O_W - O_H) \times A \times \frac{1}{T} \text{ ohms/cm}^2 \text{ per mm thickness}$$

where

O_W = resistance in ohms of separator without hole,

O_H = resistance in ohms of separator with hole,

A = area of the hole in cm^2, and

T = separator web thickness in mm.

A-2. DC METHOD

A-2.1 General

A-2.1.1 The resistance testing of separators is carried out by using a Wheatstone bridge circuit. Two arms of the bridge are provided by resistors (fixed plus variable) and the other two by the test cell.

A-2.1.2 The test cell consists of two cells combined into a single unit with a common negative and two separate positive plates. There is provision for insertion of a separator in one arm of the test cell.

*Specification for sulphuric acid (*second revision*).

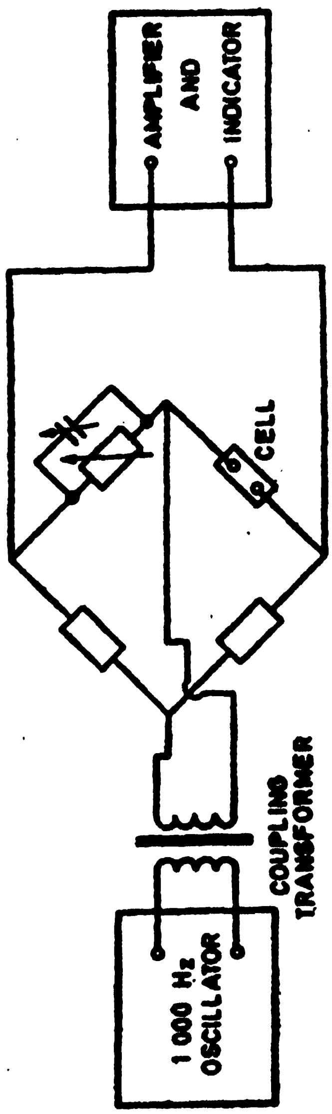


Fig. 3 Circuit Diagram for Measuring Separator Resistance by ac Method

A-2.1.3 The bridge is brought into balance before the separator unde test is inserted in the slot. Insertion of the separator unbalances th bridge, the unbalance being measured by a millivoltmeter.

A-2.1.4 The test cell is shown in Fig. 4 and circuit diagram in Fig. !

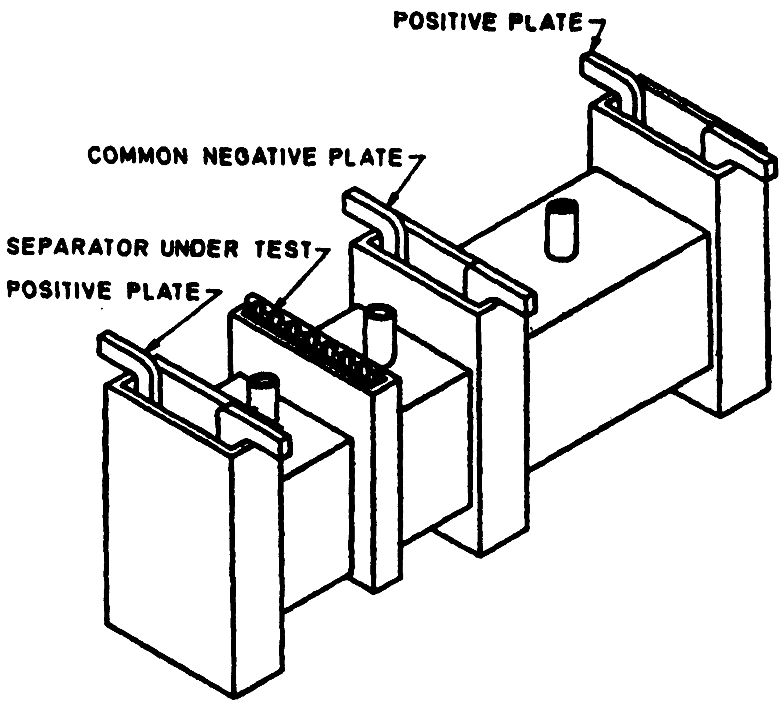


FIG. 4 TEST CELL (COMBINATION OF TEST CELL ARM AND BALANCING CELL ARM

A-2.2 Procedure

A-2.2.1 The separator is cut to a size of 95 × 150 mm and is then immersed in sulphuric acid of specific gravity 1·280 at 27°C. The time of immersion is noted. The resistance is measured 2 minutes, 5 minutes, 10 minutes, 20 minutes, 30 minutes, 1 hour, 2 hours and 24 hours afte immersion.

A-2.2.2 The bridge is fed from 100 V supply. In operation, the current through the test cell arm is adjusted to 5 A and the current through the balancing cell arm is adjusted until there is no potential differences between the two positives measured with a high resistance millivoltmeter.

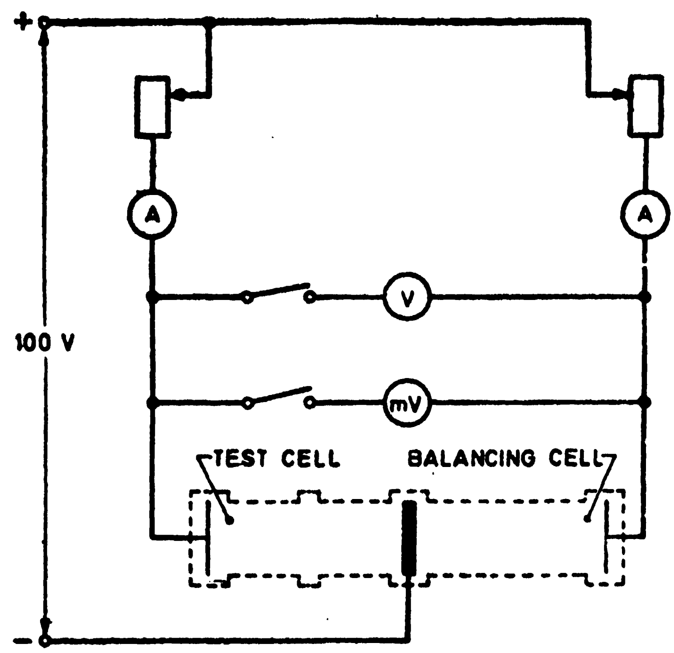


Fig. 5 Circuit for Measuring Separator Resistance by dc Method

A-2.2.3 When a separator is inserted in the window in the test cell, the resistance introduced thereby increases the potential difference across the test cell; the increase is measured by the millivoltmeter and the resistance is calculated by Ohm's law.

A-2.2.4 The resistance is expressed in ohms cm^2 per millimetre of thickness of separator and the thickness of separator is to be reported.

Note 1 — The test cell should be kept tapped with batterry grade acid of 1·280 specific gravity.

Note 2 — The plates may require a charge from time to time.

APPENDIX B

(*Clause* 7.1)

DETERMINATION OF CHLORINE CONTENT

B-0. GENERAL

B-0.1 Principle of the Method — The action of refluxing with titanous sulphate reduces perchlorates and chlorates in the solution to chlorides. Excess nitric acid then destroys unused titanous sulphate. The addition of standard silver nitrate, in the presence of nitric acid then precipitates silver chloride which coagulates by the shaking with nitrobenzene. The excess silver nitrate is back-titrated with ammonium thiocyanate according to the following equation:

$$AgNO_3 + NH_4\,CNS = Ag\,CNS + NH_4\,NO_3$$

B-1. REAGENTS

B-1.1 Dilute Nitric Acid — 50 percent.

B-1.2 Titanous Sulphate Solution — 15 percent (*w/v*).

B-1.3 Ferric Ammonium Sulphate Solution — Dissolve 10 g of ferric ammonium sulphate [$Fe_2\,(SO_4)_3\,(NH_4)_2\,SO_4.24H_2O$] in 100 ml of water and acidity with a few drops of nitric acid.

B-1.4 Standard Silver Nitrate Solution — Dissolve 4·791 47g of reagent grade silver nitrate crystals (dried for 2 hours at 150°C) in distilled water and make up the volume to 1 000 ml. One ml of this standard solution corresponds to 0·001 g of chlorine (as Cl).

B-1.5 Standard Ammonium Thiocyanate Solution — Dissolve 2·145 9 g of pure ammonium thiocyanate (NH_4 CNS) in distilled water and make up the volume to 1 000 ml. Standardize the solution by Volhard's method so that one millilitre of this solution corresponds to 0·001 g of chlorine (as Cl).

B-2. PROCEDURE

B-2.1 Weigh 10 g of finely shredded separator, transfer it to a 250 ml conical flask and cover with 100 ml of water at 60°C. Stopper and shake occasionally, while letting the contents cool, in ambient for 2 hours. Decant the extract into a 500 ml volumetric flask. Wash the conical flask and separator several times with distilled water and transfer washings to the volumetric flask. Finally make up to 500 ml with distilled water.

B-2.2 Transfer 100 ml of the aliquot (*see* **B-2.1**) into a 600 ml conical flask. Add 10 ml of titanous sulphate solution and boil gently under a water cooled reflux condenser for 30 minutes. Cool; add 10 ml of diluted nitric acid and heat gently until the excess titanous sulphate is decolourized. Cool; add exactly 10·0 ml of standard silver nitrate solution. Add a few ml of nitrobenzene and shake to coagulate the precipitate of silver chloride. Titrate the excess of silver nitrate with the standard ammonium thiocyanate solution using ferric ammonium sulphate solution as indicator. The end point of the titration is a faint permanent brown colouration which is difficult to see without considerable experience. If any doubt is felt about the end-point, it should be compared against a similar solution containing dilute sulphuric acid, nitrobenzene, ferric ammonium sulphate solution and one drop of standard ammonium thiocyanate solution which gives the colour of the end-point. A blank should be run on the titanous sulphate, exactly as described above.

B-3. CALCULATION

B-3.1 Weight of chlorine in mg in 100 g of separator =

$$\left[\begin{pmatrix}\text{Vol in ml of}\\ AgNO_3\ \text{solution}\end{pmatrix} - \begin{pmatrix}\text{Vol in ml of}\\ NH_4\ \text{CNS in}\\ \text{solution}\end{pmatrix}\right] \times \frac{500}{\text{Vol in ml of aliquot}} \times \frac{100}{\text{Weight in g of separator}}$$

APPENDIX C

(*Clause* 8.1)

DETERMINATION OF IRON CONTENT

C-1. REAGENTS

C-1.1 Sulphuric Acid — 5 N.

C-1.2 Potassium Permanganate Solution — Approximately one percent.

C-1.3 Ammonium Thiocyanate Solution — Approximately 10 percent.

C-1.4 Standard Iron Solution — Dissolve 1·404 g of ferrous ammonium sulphate in 100 ml of water. Add 25 ml of sulphuric acid of 1·200 specific gravity followed drop by drop by one percent solution of potassium permanganate to a slight excess. Transfer the solution to a 2-litre flask and dilute to the mark. This solution contains 0·10 mg of iron per ml of the solution.

C-2. PROCEDURE

C-2.1 Break, tear or shred 10 g of separator into suitable small strips and put into a clean 250 ml glass-stoppered wide-mouthed bottle. Add

250 ml of sulphuric acid and allow to stand for 18 hours at room temperature. Transfer the acid to a 500 ml graduated flask. Rinse the bottle and the separator several times with distilled water and pour rinsings into the flask. Make up the solution in the flask up to 500 ml with distilled water and mix thoroughly. Pipette an aliquot of the above (usually 25 to 30 ml) into a beaker, heat to near boiling and add potassium permanganate solution drop by drop until the slight pink colour does not disappear after 3 or 4 minutes. When the permanent colour is secured, transfer the solution to a 100 ml Nessler tube and cool under the tap. When cooled add 5 ml of ammonium thiocyanate solution and dilute to the mark.

C-2.1.1 Carry out a blank test with the 60 ml of standard iron solution following the same procedure as under **C-2.1**, using the same quantities of reagents without the separator sample. Compare the colour developed in the two Nessler tubes.

C-2.1.2 The iron in the separator shall be taken to be within the permissible limit if the intensity of the colour produced in the test with the separator is not deeper than that produced in the blank test containing the permissible quantity of iron as added from the standard solution (*see* **C-1.4**).

APPENDIX D

(*Clause* 9.1)

DETERMINATION OF MANGANESE CONTENT

D-1. REAGENTS

D-1.1 Concentrated Sulphuric Acid — Sp gr 1·84 (conforming to IS : 266-1977*).

D-1.2 Orthophosphoric Acid — Approximately 85 percent.

D-1.3 Potassium Periodate — Solid.

D-1.4 Standard Manganese Sulphate Solution — Dissolve 0·406 g of manganese sulphate crystals in approximately 20 ml of water. Add 20 ml of concentrated sulphuric acid followed by 5 ml of orthophosphoric acid. Add 3·0 g of potassium periodate and boil the solution for 2 minutes, and after cooling, dilute to 1 litre. Further dilute 100 ml of this solution to 1 litre. One ml of the final solution corresponds to 0·01 mg of manganese. The solution shall be stored in a cool dark place.

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*Specification for sulphuric acid (*second revision*).

D-1.5 Standard Potassium Permanganate Solution — Dissolve 0·287 3 g of potassium permanganate in 1 litre of water to which 1 ml of concentrated sulphuric acid has been added. Dilute 100 ml of this solution to 1 litre so that 1 ml of the final solution corresponds to 0·01 mg of manganese. Store the solution in a cool place in amber-coloured glass-stoppered bottles.

D-2. PROCEDURE

D-2.1 Select at least eight separators at random and break them into small chips. After thorough mixing, take a sample of about 10 to 12 g and place it in a tared weighing bottle. Oven-dry the sample for 16 hours at 105 ± 2°C, weigh accurately and transfer to a platinum or silica dish. Ignite the material in a muffle furnace at a dull red heat for approximately 1 hour. If necessary, stir the ash with a piece of platinum wire to ensure complete combustion. Cool the ash in desiccator, moisten with water, add 2 to 3 ml of concentrated sulphuric acid followed by 0·5 ml of concentrated orthophosphoric acid. Add 10 ml of water and heat the dish and its contents on a boiling water-bath until all the material is dissolved. If there is any insoluble residue or turbidity, filter the solution. Transfer the solution to a 100 ml beaker, using sufficient water to provide approximately 50 ml of solution. Add 0·3 g of potassium periodate, boil the solution for 2 minutes and, after cooling, make it up to 50 to 100 ml depending on the colour obtained, and compare by a suitable comparator with the standard manganese sulphate solution. Conduct control determinations on the reagents and apply corrections, if necessary. Express the amount of manganese present as milligrams per 100 g of oven-dry sample.

APPENDIX E

(*Clause* 10.1)

DETERMINATION OF PREDOMINANT MAXIMUM PORE SIZE

E-1. PROCEDURE

E-1.1 The maximum pore size is determined by measuring the air pressure necessary to force the first bubble of air through a separator wetted by absolute alcohol. Figure 6 shows the apparatus built for studying the predominant maximum pore size and the air flow through the separators. The separator is fixed in the holder as shown in Fig. 7 and alcohol is allowed to stand on the separator to a depth of a few mm. Air pressure is applied from underneath the surface. It is gradually increased till air bubbles appear on the surface of separator. Sometimes

an individual pore may be quite large to develop an air bubble at quite a low pressure. This pressure is neglected and the pressure at which the bubbles appear over the whole surface in sufficiently large number is noted. This is taken as an indication of the predominant maximum pore size that is more or less uniform.

E-1.2 The pore size is calculated from the following formula:

$$D = \frac{30\gamma \times 10^3}{P}$$

where

D = diameter of pore in micrometre,

γ = surface tension of liquid in Newtons per metre (0·022 3 for absolute alcohol) at 27°C, and

P = observed pressure in mmHg.

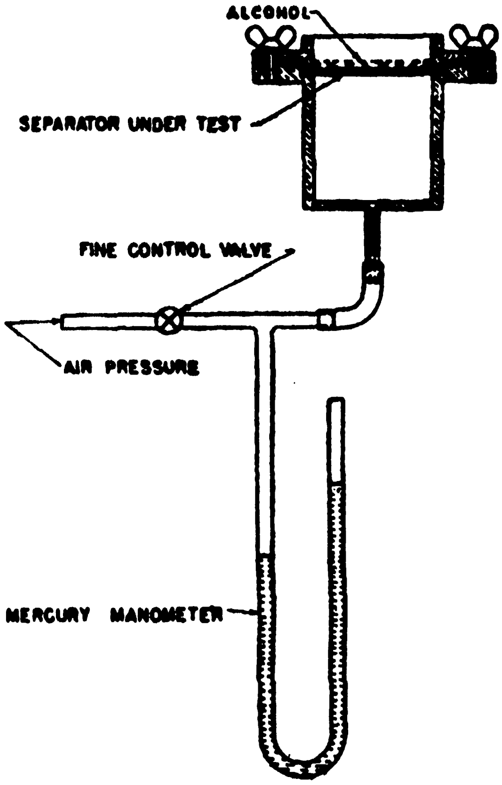
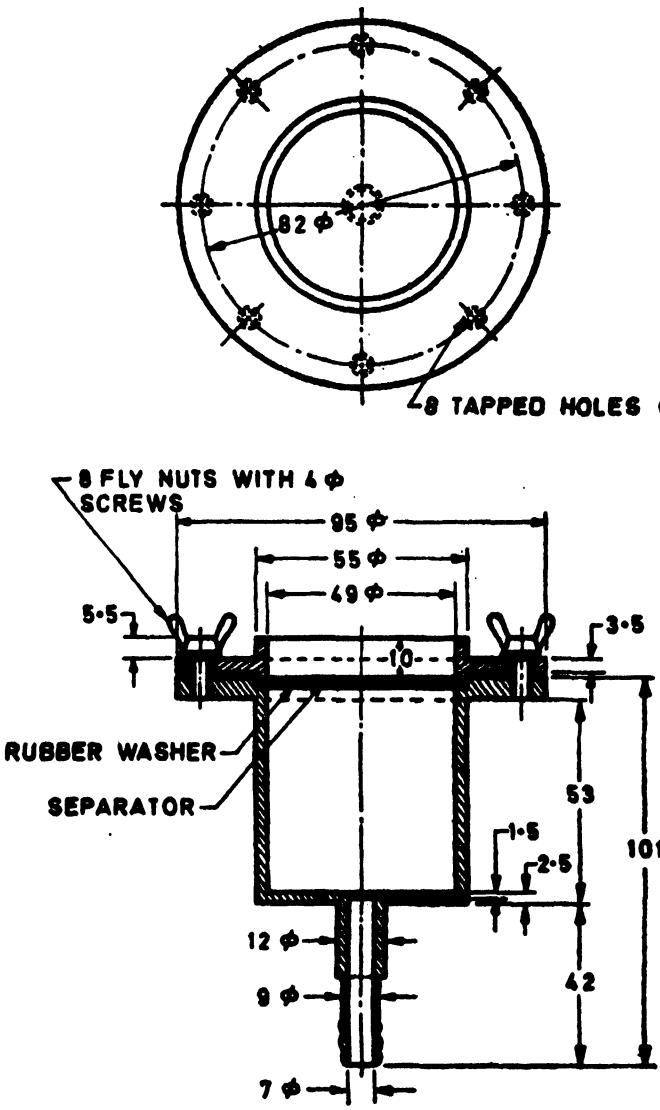


Fig. 6 Apparatus for Determination of Maximum Pore Size



All dimensions in millimetres.

FIG. 7 PERMEABILITY CELL

APPENDIX F

(*Clause* 11.1)

PERCENTAGE VOLUME POROSITY TEST FOR SEPARATORS BY SOLVENT DISPLACEMENT METHOD

F-1. SCOPE

F-1.1 Detailed method for determining the volume porosity of separator materials by solvent displacement.

F-2. SUMMARY

F-2.1 A microporous material is immersed in a liquid which will successfully wet it. The air in the pores is readily displaced by the liquid. By measuring the changes in volume due both to the solid material and the microporous area, the percentage porosity of the microporous material can be determined.

F-3. EQUIPMENT

F-3.1 Graduated Cylinder — 100 ml.

F-3.2 Rubber or Cork Stopper

F-3.3 Scissors

F-3.4 Approximately 15 cm length of 0·630 mm copper wire.

F-3.5 Acetone (technical) for microporous rubber material.

F-3.6 *Iso*propyl alcohol (technical) for microporous material.

F-4. TEST PROCEDURE

F-4.1 Using the scissors, cut the microporous material into strips 127 mm long × 19 mm wide.

F-4.1.1 To avoid cracking the material, hold the scissors on a slight angle while cutting.

F-4.2 Stack 5 strips and fasten them together by wrapping a length of copper wire around one end.

F-4.2.1 The copper wire is used to introduce and remove the sample from the liquid.

F-4.3 Fill the graduated cylinder with approximately 85 ml of the liquid, record this volume (A).

F-4.4 Immerse the strips in the liquid, shake the strips within the cylinder few times to remove trapped air, place the stopper loosely on the top of the cylinder and let stand for 10 minutes.

F-4.5 After the 10 minute stand, record the increased volume of liquid (B).

F-4.5.1 The volume of the solid material is the increase in volume of liquid, that is, $B-A$.

F-4.6 Remove the stopper and withdraw the strips from the liquid. Shake the strips lightly at the top of cylinder to allow any excess liquid adhering to the surface of the sample to drain back into the cylinder.

F-4.7 Record the volume of the liquid remaining in the cylinder (C).

F-4.7.1 This volume will be less than that of the original starting volume since we have extracted with the sample quantity of the liquid retained in the microporous material.

F-4.7.2 This decrease in volume ($A - C$) represents the volume of the pores.

F-5. CALCULATIONS

F-5.1 The percentage volume porosity is calculated by dividing the decrease in volume ($A - C$) by the sum of the increase in volume ($B - A$) and the decrease in volume ($A - C$) and multiplying the value by 100.

F-5.2 Equation

$$\text{Percentage volume porosity} = \frac{(A - C)}{(B - A) + (A - C)} \times 100$$

$$= \frac{A - C}{B - C} \times 100$$

APPENDIX G

(*Clause* 12.1)

DETERMINATION OF LIFE OF SEPARATOR UNDER PRESSURE

G-1. PROCEDURE

G-1.1 The set up for determining the life of separator under accelerated conditions is given in Fig. 8.

G-1.2 The separator under test (50 × 50 mm) is interposed between two lead blocks kept in sulphuric acid (sp gr 1·280) and connected to the positive and negative terminals of a direct current source. If the separator is ribbed, the ribbed side should face the positive of the

dc source. The lead blocks should be stoppered off with lacquer except for the portion which is in direct contact with the separator. A few more lead blocks are added to the block to make a total weight of 1 kg, so as to impress a pressure of 4 kg/dm^2 of the separator; an ampere hour meter is connected in series in the circuit to record the total current passed and to calculate the number of hours of life under constant current conditions. A constant current of 5 amperes is passed (current density 20 amperes per dm^2) between the two lead blocks. When the separator fails, the lead blocks become shorted and the voltage across the separator drops to nearly zero. This voltage difference is taken account of by an electronic relay which cuts off the dc source.

G-1.3 From the ampere hour meter reading the life of separator in hours is calculated by dividing the AH meter reading by 5.

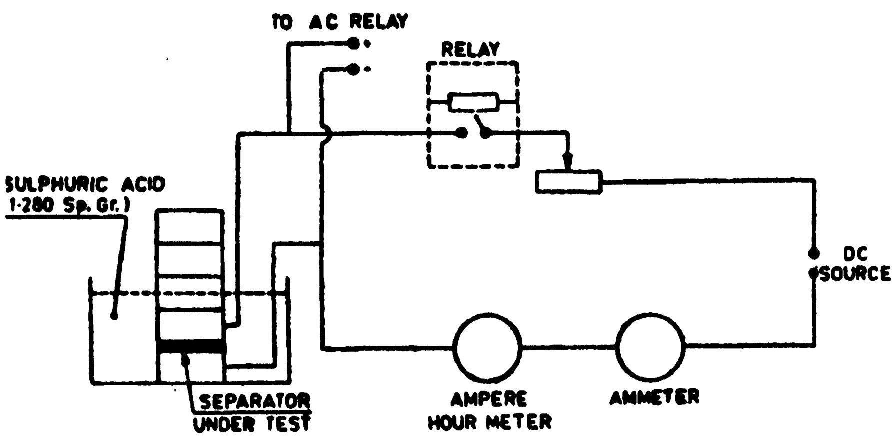


FIG. 8 ARRANGEMENT FOR ACCELERATED TESTING OF LIFE OF SEPARATOR

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Reprography Unit, BIS, New Delhi, India

AMENDMENT NO. 1 JANUARY 1988

TO

IS : 6071 - 1986 SPECIFICATION FOR SYNTHETIC SEPARATORS FOR LEAD-ACID BATTERIES

(First Revision)

(*Page* 4, *clause* **6.1**, *line* 3) — Substitute '0·75 ohms/cm^2' *for* '0·75 ohms cm^2/mm of thickness (web thickness in case of ribbed separators)'.

(*Page* 6, *clause* **14**) — Substitute the following for the existing clause:

'14. TEST FOR WETTABILITY

14.1 Place a drop of 1·280 (27°C) sulphuric acid solution with a pipette (10 cc) on the surface of the separators at room temperature.

NOTE — Equal size of drops shall always be used. The height from which the drop is placed should be approximately 1·5 cm. This is to ensure correct size of drop so that the liquid does not splash.

14.2 The drop shall be absorbed by the separators within 60 s.

14.3 Test shall be carried out on both the surfaces of the separators.'

(*Page* 6, *clause* **16.2.1**) — Substitute the following for the existing clause:

'16.2.1 Each package may also be marked with the Standard Mark.

NOTE — The use of the Standard Mark is governed by the provisions of the Bureau of Indian Standards Act 1986 and the Rules and Regulations made thereunder. The Standard Mark on products covered by an Indian Standard conveys the assurance that they have been produced to comply with the requirements of that standard under a well-defined system of inspection, testing and quality control which is devised and supervised by BIS and operated by the producer. Standard marked products are also continuously checked by BIS for conformity to that standard as a further safeguard. Details of conditions under which a licence for the use of the Standard Mark may be granted to manufacturers or producers, may be obtained from the Bureau of Indian Standards.'

(*Page* 6, *clause* **16.2.1**) — Add the following new clauses after **16.2.1**:

'17. TESTS AND PERFORMANCE

17.1 Classification of Tests

17.1.1 *Type Tests* — The following shall constitute the type tests:

a) Electrical resistance (*6.1*),

b) Chlorine content (**7.1**),

c) Iron content (**8.1**),

d) Manganese content (**9.1**),

e) Maximum predominant pore size (**10.1** and **10.2**),

f) Volume porosity (**11.1** and **11.2**),

g) Life test (**12.1** and **12.2**),

h) Test for mechanical test (**13**), and

j) Test for wettability of separator (**14.1**, **14.2** and **14.3**).

17.1.2 *Acceptance Tests* — The following tests shall constitute as acceptance tests:

a) Dimensions (**5.1**),

b) Wettability of separator (**14.1** to **14.3**), and

c) Volume porosity (**11.1** and **11.2**).

17.1.2.1 The acceptance tests shall be applied on two samples up to a maximum of 1 percent of each type in a lot, the samples being drawn at random by the purchasing or the inspecting authority.

17.1.2.2 *Criteria for acceptance* — If any of the sample separator fails in any of the acceptance tests, twice the original number of samples shall be taken and subjected to all the acceptance tests. If there is any failure in the retests, the lot may be rejected.'

(*Page* 8, *clause* **A-1.2.4**) — Substitute the following for the existing clause:

'**A-1.2.4** Report the difference in resistance with and without the hole in separator, as ohms square centimetre of the surface area of the separator. The resistance of the separator is then given by the following formula:

$$(O_W - O_H) \times A \text{ ohms}\cdot\text{cm}^2$$

where

O_W = resistance in ohms of separator without hole,

O_H = resistance in ohms of separator with hole, and

A = area of the hole in cm².'

(*Page* 10, *clause* **A-2.2.1**, *last sentence*) — Substitute the following for the existing sentence:

'The resistance is measured 2 hours after immersion.'

(*Page* 11, *clause* **A-2.2.4**) — Substitute the following for the existing clause:

'**A-2.2.4** The resistance is expressed in terms of ohm·cm² of the area of the separator.'

(*Page* 11, *clause* **A-2.2.4**) — Add the following new clause after **A-2.2.4**:

'**A-3.** Alternatively any other standard equipment based on the same principle in accordance with **A-1** and **A-2** can also be used.'

(*Page* 12, *clause* **B-1.2**) — Delete and renumber the subsequent clauses accordingly.

(*Page* 12, *clause* **B-2.2**) — Substitute the following for the existing clause:

'**B-2.2** Transfer 100 ml of the aliquot (*see* **B-2.1**) into a 600-ml conical flask. Cool, add exactly 10·0 ml of standard silver nitrate solution. Add a few millilitres of nitrobenzene and shake to coagulate the precipitate of silver chloride. Titrate the excess of silver nitrate with the standard ammonium thiocyanate solution using ferric ammonium sulphate solution as indicator. The end point of the titration is a faint permanent brown colouration which is difficult to see without considerable experience. If any doubt is felt about the end-point, it should be compared against a similar solution containing dilute sulphuric acid, nitrobenzene, ferric ammonium sulphate solution and one drop of standard ammonium thiocyanate solution which gives the colour of the end-point.'

(ETDC 11)

Reprography Unit, BIS, New Delhi, India

AMENDMENT NO. 2 JUNE 1991

TO

IS 6071 : 1986 SPECIFICATION FOR SYNTHETIC SEPARATORS FOR LEAD-ACID BATTERIES

(First Revision)

(*Page* 6, *clause* 13) — Substitute the following for 'Under consideration':

'13.1 The test shall be carried out by the method given in Appendix H.

13.2 The separator shall not break or fracture due to impact of steel ball.'

(*Page* 20, *clause* G-1.3) — Insert the following Appendix at the end:

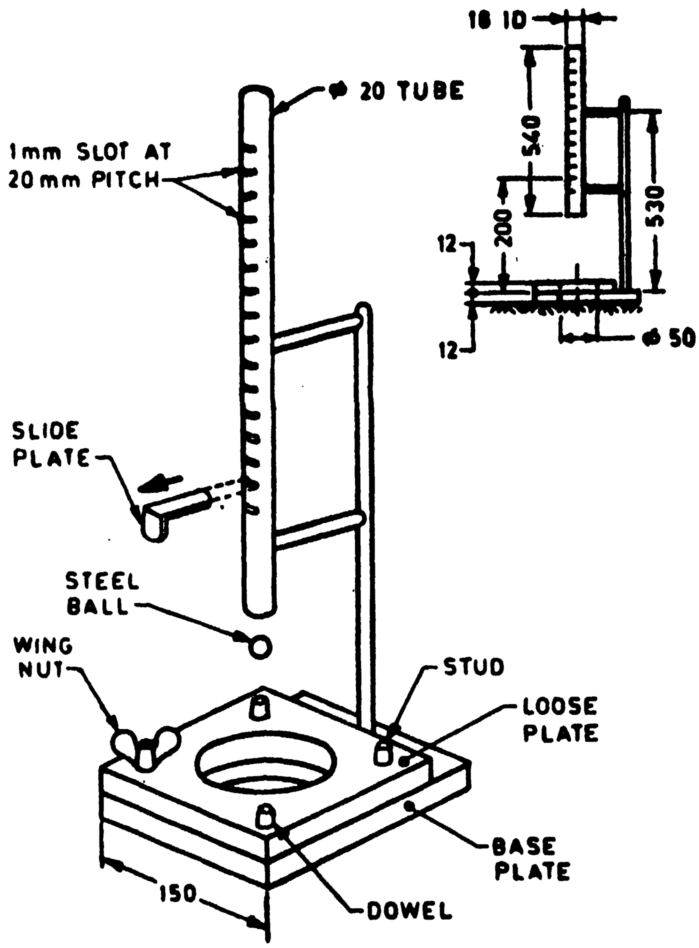
APPENDIX H
(*Clause* 13.1)

MECHANICAL STRENGTH TEST

H-1 The specimen separator shall be clamped in the jig with ribs, if any, being on the lower side (*see* Fig. 9).

H-2 A steel ball of 12·7 mm dia weighing $8{\cdot}3 \pm 0{\cdot}2$ g is dropped vertically from a height of 200 mm.

NOTE — The tube shall be so adjusted that the steel ball falls between the ribs, if any, of the separator (*ribs facing downwards*).



All dimensions in millimetres.

FIG. 9 SEPARATOR IMPACT TEST APPARATUS

(ETD 11)

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